

# **The Role of Statistics in Systems Engineering**

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***There's Lies, Damned Lies,  
and then there's  
Statistics.***

**Mark Twain**

# **The Problem with Statistics**

- **Hard! Mathematically Rigorous, yet Sloppy**
- **Esoteric - Very Poorly Understood, even by Statisticians**
- **Universally Abused and Misused**

# **SE's Business is Statistics!**

***The Primary Function of the SE  
Discipline is to Reduce Risk of  
Project Failure!***

# **Specific Examples of Statistics in SE**

- **Mission Analysis - Required Probability of Mission Success, Feasibility Analysis**
- **Schedule Requirements Imply Operational Availability and System Reliability Requirements**
- **Some Requirements Should be Statistically Stated**
- **Statistical Requirements Must be Allocated Statistically**
- **Verification - ANOVA, Taguchi Designs for Verification**
- **Risk Management - Risk is Statistically Formulated**

# More Examples

- **Quality Systems Engineering - Conformance to Requirements, Statistical Process Control**
- **Systems Effectiveness, Modeling and Simulation, Systems Synthesis**
- **Failure Analysis, FMECA**
- **Project Execution and Operations Planning**
- **Logistics**
- **Safety**

# **Needs for Statistics in INEEL SE**

- **All Projects Schedule Driven, Hence RAM Analysis**
- **RAM Analysis Should be Systems Design Driver**
- **Statistical Requirements and Verification Plans**
- **Public, CAB have Unrealistically High Expectations**
- **Poor Understanding of Statistics by Customers**
- **All INEEL Projects Safety Driven - All ROD's Have Criterion of "Overall Protection of Human Health and Environment"**

# **SE Statistical Competency Requirements**

- **Ability to Recognize when Statistical Requirements are Needed and How to State Them**
- **Sufficient Practical Engineering Statistics Understanding to Identify and Explain Abuse and Misuse**
- **Ability to Solve Most Systems Statistical Problems and Consult Effectively with Professional Statisticians**
- **Ability to Understand Statistical Modeling and Simulation to Synthesize and Validate the Better Solution**
- **Ability to Allocate Statistical Requirements and Develop Verification Plans**



# Naked Proselytization

- **U of I Masters Program in SE offers:**
  - **SYS 504, Analytical Methods, Numerical and Computational Methods**
  - **SYS 520, Probability and Statistics I, Basic Probability and Statistical Methods - Prerequisite: Sys 504**
  - **SYS 521, Probability and Statistics II, Modeling and Simulation Techniques - Prerequisite: SYS 520**

# Summary

- **Statistics is the Bread and Butter for SE**
- **Statistics is Poorly Understood and Misused by the Customers**
- **Failure to Effectively Consider the Statistical Aspects of a Project Leads to Project Failure**